DOCUMENT RESUME

ED 237 541 TM 830 803

AUTHOR Hymel, Glenn M.
TITLE Contributions of Mastery Learning to the Science of Teaching.
PUB DATE Apr 83
NOTE 39p.; Paper presented at the Annual Meeting of the American Educational Research Association (67th, Montreal, Quebec, April 11-15, 1983).
PUB TYPE Speeches/Conference Papers (150) -- Viewpoints (120)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Style; Educational Environment; Educational Psychology; *Instructional Design; *Mastery Learning; Student Characteristics; *Teacher Effectiveness; *Teaching Models

ABSTRACT

Effective teaching is a multifaceted endeavor comprised of process, product, artistic, and scientific aspects. The scientific dimension pertains to that multidisciplinary accumulation of systematic knowledge which makes possible the prediction and control of human behavior as it relates to the events comprising instruction and learning. This paper suggests that any responsible discussion of the science of teaching must give serious consideration to those contributions made by (1) the conceptual, functional, and research dimensions of mastery learning, and (2) those points of merger between mastery learning and instructional psychology known as instructional design, conditions of learning, student learning styles, and models of teaching. (Author)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED237541

Contributions of Mastery Learning to the Science of Teaching

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Glenn M. Hymel

Loyola University, New Orleans

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

G. M. Hymel

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Paper presented at the annual meeting of the American Educational Research Association, Montreal, April 1983.

TM830803

Abstract

Effective teaching is a multifaceted endeavor comprised of process, product, artistic, and scientific aspects. The scientific dimension pertains to that multidisciplinary accumulation of systematic knowledge which makes possible the prediction and control of human behavior as it relates to the events comprising instruction and learning. This paper suggests that any responsible discussion of the science of teaching must give serious consideration to those contributions made by (a) the conceptual, functional, and research dimensions of mastery learning and (b) those points of merger between mastery learning and instructional psychology known as instructional design, conditions of learning, student learning styles, and models of teaching.

Contributions of Mastery Learning to the Science of Teaching

The act of effective teaching may be characterized from two different perspectives which relate to process and product dimensions but which are not mutually exclusive. From the process-oriented view, teaching represents the design of an educational environment which encourages and facilitates learning; from the product-oriented standpoint, teaching involves the efficient instrumental causation of learning (Hymel, 1976, 1978, 1979, in press). Compatible with each viewpoint is the position that teaching encompasses an artistic feature as well as a scientific basis (see Gage, 1978). Table 1 displays the interrelated process-product and artistic-scientific aspects of effective teaching.

Insert Table 1 about here

With respect to the artistic feature, the focus here is on the notion that teaching is a cooperative art in that teaching helps nature do what it can do itself--though not as well--without it (Adler, 1963). The thirteenth century philosopher and theologian, St. Thomas Aquinas, touched on this theme of teaching as a cooperative art by an appeal to the following analogy:

> As there are two ways of being cured, that is, either through the activity of unaided nature or by nature with the aid of medicine, so also there are two ways of acquiring knowledge. In one way, natural reason by itself reaches knowledge of unknown things, and this way is called discovery; in the other way, when someone else aids the learner's natural reason, and this is called learning by instruction. . . .

> Through the instrumentality, as it were, of what is told him, the natural reason of the pupil arrives at a knowledge of the things which he did not know. Therefore, just as the doctor is said to heal a patient through the activity of nature, so a man is said to cause knowledge in another through the activity of the learner's own natural reason, and this is teaching. (De Verit., q.11, a.1, c; p. 83)

In a way which complements our brief characterization thus far of teaching as a cooperative art, Gage (1978) highlights the theme of teaching as a practical art in the following manner:

> Teaching is, of course, a useful, or practical, art rather than one dedicated to the creation of beauty and the evocation of aesthetic pleasure as ends in themselves. As a practical art, teaching must be recognized as a process that calls for intuition, creativity, improvisation, and expressiveness--a process that leaves room for departures from what is implied by rules, formulas, and algorithms. In teaching, by whatever methods it proceeds--even in the fixed programs of computer-assisted instruction--there is a need for artistry: in the choice and use of motivational devices, clarifying definitions and examples, pace, redundancy, and the like.
>
> When teaching goes on in face-to-face interaction with students, the opportunity for artistry expands enormously. No one can ever prescribe successfully all the twists and turns to be taken as the lecturer, the discussion leader, or

> the classroom teacher uses judgment, sudden insight, sensitivity, and agility to promote learning. (p. 15)

With respect to the scientific basis of teaching, the emphasis here is on that multidisciplinary accumulation of systematic knowledge which makes possible the prediction and control of human behavior as it relates to the events comprising instruction and learning. The multidisciplinary reference is to that input provided by such disciplines as psychology, sociology, philosophy, history, and anthropology regarding factors which are likely to impact teachers and students in any instructional endeavor. The prediction and control notions are in terms of relationships between teacher-behavior variables and student-behavior variables that have been established analytically and/or empirically. In essence, then, education is a professional field of study which relies quite heavily on certain academic disciplines for its scientific basis. More specifically, teaching is a form of professional practice which finds its scientific basis in the contributions that the aforementioned disciplines make to identifying predictive and causal relationships among relevant variables (cf. Gage, 1978)

In synthesizing and interrelating the artistic, scientific, and professional aspects of teaching, Gage (1978) makes the following observations:

> In medicine and engineering, where the scientific basis is unquestionable, the artistic elements also abound. In teaching, where the artistic elements are unquestionable, a scientific base can also be developed. These professions are not

in themselves sciences: they merely have scientific bases. To practice medicine and engineering requires a knowledge of much science: concepts, or variables, and their interrelations in the form of strong or weak laws, generalizations, or trends. But using science to achieve practical ends requires artistry--the artistry that enters into knowing when to follow the implications of the laws, generalizations, and trends, and, especially, when not to, and how to combine two or more laws or trends in solving a problem.

In practical affairs, the laws and trends relating any two variables are subject to modification by the influence of third variables and many more variables. These influences of third and additional variables are called interactions. When any additional variable interacts to influence the relationship between two variables, we are unwise to follow the implications of a simple two-way relationship. (p. 18)

Scientific method can contribute relationships between variables taken two at a time and even, in the form of interactions, three or perhaps four or more at a time. Beyond say four, the usefulness of what science can give the teacher begins to weaken, because teachers cannot apply, at least not without help and not on the run, the more complex interactions. At this point, the teacher as artist must step in and make clinical, or artistic, judgments about the best ways to teach. In short, the scientific base for the art of teaching will consist of two-variable relationships and lower-order

> interactions. The higher-order interactions between four and more variables must be handled by the teacher as artist. (p. 20)

Having considered in a general way the artistic feature and scientific basis of teaching, let us now turn our attention to certain aspects of the science of teaching which borrow heavily from the discipline of psychology. More to the point, let us now consider (a) mastery learning as a set of optimistic assumptions regarding the capability of students to learn and as an array of instructional specifications and functions served, both of which have far-reaching implications relative to research on learner-oriented and instruction-oriented variables, and (b) instructional psychology as that subsumer of mastery learning which most comprehensively relates the behavioral science of psychology to the enhancement of teaching and learning. It is hoped that this topical coverage will serve to relate mastery learning to instructional psychology from conceptual, functional, and research perspectives. Furthermore, it is anticipated that both mastery learning and instructional psychology will be recognized as major contributors to the science of teaching, thus aiding in the endeavor to place the efforts of teachers and learners on a more dependable and predictable basis rather than being at the mercy of chance factors.

Mastery Learning

Mastery learning has been characterized repeatedly in the professional literature as encompassing (a) a set of optimistic assumptions regarding the capability of students to learn the contents of a course/unit to a high degree of competency provided that the learning conditions are maximized, (b) an array of functions or purposes served by those instructional components comprising the preparatory, delivery, and evaluative tasks of diagnostic-prescriptive teaching, and (c) a taxonomy of research questions providing direction to the analytical and/or empirical investigation of learner-oriented and instruction-oriented variables thought to be alterable (see Anderson, 1975, 1979; Anderson & Anderson, 1982; Anderson & Block, 1977, 1983; Anderson & Jones, 1981; Block, 1971, 1973, 1974, 1977, 1979, 1980; Block & Anderson, 1975; Block & Burns, 1976; Bloom, 1968, 1971a, 1971b, 1976, 1978, 1980).

With respect to the conceptual dimension of mastery learning, the mastery learning model assumes that the majority of students in a course can indeed learn the contents of the course to a high degree of competency provided that the learning conditions are optimal. The principal focus here has been on the anticipated outcomes of a mastery learning strategy in the following two domains: (a) cognitive consequences which encompass greater initial learning, retention of learning, transfer of learning, and facility in learning how to learn; and (b) affective consequences which entail more positive attitudes toward the subject and/or schooling, increased confidence among students regarding their ability to learn, and probable beneficial impact on self-concept and mental health. Perhaps the most revolutionary notion within the

mastery learning paradigm's assumptions regarding student capability to learn is the third part of the following three-phase construct development acknowledged by Bloom (1976) in his Human Characteristics and School Learning:

> 1. There are good learners and there are poor learners. . .
>
> 2. There are faster learners and there are slower learners. . . .
>
> 3. Most students become very similar with regard to learning ability, rate of learning, and motivation for further learning--when provided with favorable learning conditions. (pp. ix-x)

Regarding the functional dimension of mastery learning, the principal purpose/rationale here has been that of adaptive or diagnostic-prescriptive teaching along with criterion-referenced evaluation, accomplished within the overall context of the following instructional specifications: (a) preconditions, that is, teacher adoption of a mastery learning view, formulation of what is meant by subject mastery, organization of a course into a sequence of small instructional units, and development of feedback-correction procedures for each unit; and (b) operating procedures, that is, orient the students to mastery learning procedures, teach the unit via the usual group-based methods, administer the formative test(s), prescribe the learning correctives as needed and/or certify appropriate student progress, and administer the summative test.

With respect to the research dimension of mastery learning, Block and Burns (1976) have suggested in their state-of-the-art review of the

mastery learning literature a taxonomy of research questions comprised of the following four categories:

Type I mastery learning research (MLR) represents the earliest kind and focuses on the question "Does it work?"

Type II MLR represents a logical sequel to the aforementioned in that it begins to look beyond the immediate cognitive effects of mastery learning strategies on students and to focus on the question "If it works, then what might follow?" The expanded focus here is on such areas as affective consequences; time considerations; learning-to-learn effects; and teacher-role, administrative, curricular, sociological, and economic implications.

Type III MLR addresses the following two kinds of studies and related research questions: (a) student-entry characteristic studies which focus on the question "Do mastery strategies have the same effects on different kinds of students, i.e., students with different kinds of cognitive and affective entry characteristics?" and (b) component studies which ask "Do some components of mastery strategies have greater effects on students than other components?"

Type IV MLR attempts to translate findings about why mastery strategies work into statements of how they can be implemented and, hence, focuses on the question "How does it work?"

Due to its implied focus on the interactions between learner-oriented and instruction-oriented variables considered alterable in nature, it would seem that the Type III genre of MLR encompasses the greatest potential for researchers and practitioners interested in exploring and advancing the conceptual and functional dimensions of mastery learning and, thereby, contributing to the science of teaching as

characterized earlier. A catalyst for the advent of Type III MLR has been the relatively recent recognition of and increasing attention devoted to that specialty within the discipline of psychology known as instructional psychology (see Atkinson, 1972, 1976; Gagné & Dick, 1983; Gagné & Rohwer, 1969; Gehlbach, 1979; Glaser, 1976, 1978, 1982; Glaser & Resnick, 1972; McKeachie, 1974; Resnick, 1981; Snow, 1977; Wittrock, 1979; Wittrock & Lumsdaine, 1977). However, the full potential of Type III MLR and its intrinsic reliance on the broad scope of instructional psychology have yet to be recognized fully. The principal intent of the next section of this paper, then, is to survey briefly the field of instructional psychology with a specific view toward identifying those areas which relate directly to the student-entry characteristic and instructional-component features of Type III MLR and which, therefore, hold the most promise for advancing the science of teaching.

Instructional Psychology

As pointed out by Robert Glaser (1978) in his edited work entitled Advances in Instructional Psychology (Vol. 1), the expression instructional psychology was first used to identify an area of focus in the 1969 edition of the Annual Review of Psychology. Glaser goes on to suggest that this field of study

> has taken on enough shape that it can be generally characterized as consisting of research on the acquisition of knowledge and cognitive skill and how this competence is developed through the design of conditions for learning. (p. ix)

Since its formal introduction in 1969, the topic of instructional psychology has comprised a chapter in the Annual Review of Psychology on six different occasions, with each survey emphasizing a different thrust inherent in this multifaceted field which relates the discipline of psychology to the science of teaching.

Gagné and Rohwer (1969), for example, chose to introduce instructional psychology to the academic community via an emphasis on what they labelled the events of instruction; namely, gaining and maintaining attention, directing and preparing the learner, presenting stimuli, prompting and learning guidance, conditions of responding, providing feedback, promoting retention, and conditions affecting transfer. Three years later, Glaser and Resnick (1972) focused their instructional psychology chapter on a theme that could be identified as characteristics of a prescriptive instructional theory for the optimization of learning, with particular attention devoted to analyzing learning tasks, diagnosing learner characteristics, and designing instructional environments. In 1974, McKeachie's instructional psychology contribution to the Annual Review of Psychology centered on the question "What factors influence the effectiveness of instruction?" Wittrock and Lumsdaine (1977) chose to organize their review of instructional psychology around the notable shift in psychological research and theory from behaviorism to cognitive psychology. Resnick's (1981) chapter on instructional psychology advanced even further the cognitive psychology thrust of Wittrock and Lumsdaine (1977) just mentioned. Resnick notes, for example, that

> it is now difficult to draw a clear line between instructional psychology and the main body of basic research on complex

> cognitive processes. Instructional psychology is no longer basic psychology applied to education. It is fundamental research on the processes of instruction and learning. . . .
>
> Having become part of the mainstream, it is not surprising that instructional psychology is participating in the important shifts that are occurring in many other branches of psychology. Instructional psychology, like most research on human learning and development, is now largely cognitive; it is concerned with internal mental processes and how their development may be enhanced through instruction. (p. 660)

Most recently, Gagné and Dick (1983) have provided a more global survey of instructional psychology which focuses on such diverse areas as general contributory works, instructional theories, relevant concepts in cognitive psychology, ATI research, and applications.

Not surprisingly, this brief overview of six benchmark reviews of instructional psychology published over the past 14 years suggests three global issues: (a) features of learning tasks, (b) learner-oriented characteristics, and (c) instruction-oriented activities. These global issues, furthermore, are indeed related in whole or at least in part to research in the specific areas of instructional design (e.g., Briggs, 1977; Dick & Carey, 1978; Gagné & Briggs, 1979; Glaser, 1976; Hymel, Note 1, in press; Merrill, 1971), conditions of learning (e.g., Gagné, 1974, 1977; Gagné & Briggs, 1979), student learning styles (e.g., Dunn & Dunn, 1978; Gregorc, 1979a, 1979b; Hill, 1970, 1981; Hunt, 1971, 1977-78; Keefe, 1979), and models of teaching (e.g., Joyce, 1978; Joyce, Brown, & Peck, 1981; Joyce & Weil, 1980).

It is precisely in these research areas of instructional design, conditions of learning, student learning styles, and models of teaching--each of which is subsumed under one or more of the three global issues mentioned above--that the student-entry characteristic and instructional-component features of Type III MLR relate most directly to the field of instructional psychology and contribute quite significantly to the science of teaching.

Advancing the Science of Teaching: The Appeal to Instructional Design, Conditions of Learning, Student Learning Styles, & Models of Teaching

Instructional Design

The three global issues permeating instructional psychology are indeed consistent with the following components of a psychology of instruction identified by Glaser (1976) as essential to the design of instructional environments: (a) analysis of the competent performance to be achieved, (b) description of the initial state of the learner from which learning proceeds, (c) conditions that can be implemented to bring about a change from the initial state of the learner to the state of competence desired, and (d) assessment of the immediate and long-range effects of instructional implementation.

In a similar fashion, I (Hymel, Note 1, in press) have suggested a comprehensive model which reflects (a) the three organizational levels of instructional design--the program syllabus, course syllabus, and instructional unit levels--and (b) the three sequential phases or activities of instruction that are designed at the unit level--preparing students to receive instruction, delivering instruction, and evaluating student performance.

Perhaps the most obvious level at which Type III MLR relates to instructional design is at the instructional unit level of organization. It is at this level that one encounters the greatest degree of instructional design specificity regarding the preparation, implementation, and evaluation activities that bring the instructor into direct contact with the students. More directly, it is at the instructional unit level that the following crucial activities are addressed: specifying performance objectives and the appropriate levels of proficiency; identifying and/or assessing prerequisite student characteristics of a cognitive and affective nature; identifying and justifying topical coverage; sequencing content in a logical and hierarchical fashion; selecting/implementing instructional methods, student activities, and resources reflective of the type(s) of learning addressed and the prerequisite student characteristics; providing for diagnostic-prescriptive teaching via the use of formative tests and learning correctives; and evaluating in a summative fashion. Obviously, this sequence of activities encompasses both the student-entry characteristic and the instructional-component features of Type III MLR and, therefore, represents an essential aspect of the instructional design theme within instructional psychology that can guide future mastery learning research of the Type III genre and thereby advance the scientific basis of teaching.

Outcomes, Events, and Conditions of Learning

When one considers the discussion thus far of (a) the three global issues permeating the field of instructional psychology and (b) the two dimensions of Type III MLR, it should become apparent that both

realms are quite comprehensively covered by the extensive work of Robert Gagné and his colleagues in the area of outcomes, events, and conditions of learning (Gagné, 1974, 1977; Gagné & Briggs, 1979).

In his work entitled The Conditions of Learning (3rd ed.), Gagné (1977) explains the relationship that exists between the varieties of learning outcomes that individuals can demonstrate and the conditions (both internal and external) of learning that must exist so as to facilitate the various outcomes. Gagné (1977) succinctly introduces this relationship as follows:

> There are several varieties of performance types that imply different categories of learned capabilities. These varieties of performance may also be differentiated in terms of the conditions for their learning. In searching for and identifying these conditions, one must look, first, at the capabilities internal to the learner and, second, at the stimulus situation outside the learner. The learning of each type of new capability starts from a different "point" of prior learning, and is likely also to demand a different external situation. (p. 20)

Additionally, Gagné speaks of certain events of learning that mediate or connect the varieties of learning outcomes with the internal and external conditions of learning. The dynamics here are such that the events of learning--conceived of in the context of the information-processing model of learning and memory--are considered in relation to each variety of learning outcomes, thus suggesting a given set of internal and external conditions essential to promoting each learning outcome.

Hence, it is implied that there exists a threefold linkage among varieties of learning outcomes, events of learning, and conditions of learning. More specifically, the varieties of learning outcomes include the following: intellectual skills, cognitive strategies, verbal information, motor skills, and attitudes. The events of learning span such learning phases as motivation (hence, expectancy), apprehending (attention; selective perception), acquisition (coding; storage entry), retention (memory storage), recall (retrieval), generalization (transfer), performance (responding), and feedback (reinforcement). Finally, the conditions of learning are both internal and external; the former referring to previously learned capabilities that already exist in the individual before any particular new learning begins and the latter pertaining to elements comprising the stimulus situation outside the learner which represent different manifestations of one or more of the following instructional events: activating motivation, informing the learner of the objective, directing attention, stimulating recall, providing learning guidance, enhancing retention, promoting transfer of learning, eliciting performance, and providing feedback.

Gagné's conceptualization of the internal conditions of learning represents a potentially fertile area of research for the student-entry characteristic feature of Type III MLR; likewise, his notion of the external conditions of learning relates to possible Type III MLR touching on the instructional-component dimension. The varieties of learning outcomes, of course, represent Gagné's view of that broad range of possible learning tasks which spans the cognitive, affective, and psychomotor realms. Finally, in terms of a variable-oriented framework

for mastery learning researchers, it would seem that the outcomes, events, and conditions of learning articulated by Gagné suggest potential dependent, intervening, and independent variables, respectively, that are worthy of investigation.

Student Learning Styles

James W. Keefe (1979), in the introductory chapter of an NASSP publication entitled Student Learning Styles: Diagnosing and Prescribing Programs, defines learning styles as "characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (p. 4). He then goes on to characterize each of the three components of learning style as follows: (a) cognitive styles are information-processing habits that have to do with reception, concept formation, and retention; (b) affective styles are motivational processes that relate to attention, expectancy, and incentives; and (c) physiological styles are biologically-based response modes that emanate from such areas as sex-related differences, nutritional habits, health status, and accustomed reactions to environmental stimuli. Table 2 represents a framework suggested by Keefe for considering the various learning style components and those dimensions subsumed under each component.

Insert Table 2 about here

Subsequent to an excellent summary of the student-characteristic, instruction-oriented, and learning-outcome variables in the theory of

school learning proposed by Bloom (1976) in his Human Characteristics and School Learning, Keefe (1979) proceeds to make the following observation:

> Bloom's model envisions school learning primarily from the instructional perspective. It deals with prior learning and motivation, the nature of the learning task(s) and indicators of learning effectiveness. It is not directly concerned with the wide variety of approaches that a teacher may utilize in creating a learning environment. Nor does it consider variations in student learning style. Both teaching and learning styles, then, are worthy subjects for further conceptualization. (pp. 3-4)

It should be pointed out that Keefe's comment about the Bloom model, when taken in the full context of the former's overview of learning style, is in terms of acknowledging a delimitation rather than a limitation imposed by Bloom which does not lessen the value of the model.

At the same time, however, the suggestion that the subject of student learning style is worthy of further conceptualization should not be taken lightly. The relationship that exists among (a) the global issue of learner-oriented characteristics within the field of instructional psychology, (b) the student-entry characteristic feature of Type III MLR, and (c) the full range of learning style components which spans cognitive style, affective style, and physiological style should be apparent. More specifically, it is the method-relevant cognitive and affective entry characteristic dimension of Type III MLR

that lends itself to greater elaboration and a certain degree of extension if examined in the context of learning style research.

One example among many of such a line of inquiry might be that of relying on the learning style profile of a given student as a basis for designing the learning correctives and/or learning enrichment component(s) of a mastery strategy. The methodological and design focus of such an approach would obviously be a variation of the aptitude-treatment interaction (ATI) theme perhaps best represented by the efforts of Cronbach and Snow (1977). Additionally, such an emphasis on ATI research would indeed accommodate Gage's (1978) contention that a major aspect of the science of teaching involves the delineation of two-variable relationships as well as first- and second-order interactions.

Models of Teaching

Exhaustive work has been done in the area of identifying and classifying models of teaching (or teaching styles) as based on the general orientation and purpose of each of several instructional delivery approaches (see Joyce, 1978; Joyce, Brown, & Peck, 1981; Joyce & Weil, 1980). As delineated by Joyce and Weil (1980) and Joyce (1978), there are four families of models that represent distinct orientations toward people and how they learn: (a) information-processing models, (b) personal models, (c) social interaction models, and (d) behavioral models.

The information-processing family of models is oriented toward the capability of students to process information and the strategies available to improve their ability to master information. Models and

theorists included in this family are as follows: (a) inductive thinking; Hilda Taba; (b) inquiry training; Richard Suchman; (c) scientific inquiry; Joseph L. Schwab; (d) concept attainment; Jerome Bruner; (e) cognitive growth; Jean Piaget, Irving Sigel, Edmund Sullivan, and Lawrence Kohlberg; (f) advance organizer; David Ausubel; and (g) memory; Harry Lorayne and Jerry Lucas.

The personal family of models focuses on individual development, self-awareness, and interpersonal responsibility. Models and theorists here include: (a) nondirective teaching; Carl Rogers; (b) awareness training; Fritz Perls and William Schutz; (c) synectics; William Gordon; (d) conceptual systems; David Hunt; and (e) classroom meeting; William Glasser.

The social interaction family of models emphasizes the individual's relationship to social groups and society at large with a reliance on the democratic process as a means to social productivity. Models and theorists representing this family are: (a) group investigation; John Dewey and Herbert Thelen; (b) social inquiry; Byron Massialas and Benjamin Cox; (c) laboratory method; National Training Laboratory; (d) jurisprudential; Donald Oliver and James P. Shaver; (e) role playing; Fannie Shaftel and George Shaftel; and (f) social simulation; Sarene Boocock and Harold Guetzkow.

The behavioral family of models is based on operant conditioning and reinforcement theory with emphasis on changing the overt behavior of the learner. Comprising this family are the following models and theorists: (a) contingency management; B. F. Skinner; (b) self-control; B. F. Skinner; (c) relaxation; David Rimm, John Masters, and J. Wolpe;

(d) stress reduction; David Rimm, John Masters, and J. Wolpe; (e) assertive training; J. Wolpe, Arnold Lazarus, and A. Salter; (f) desensitization; J. Wolpe; and (g) direct training; Robert Gagné, Karl Smith, and Margaret Foltz Smith.

The global issue in instructional psychology which subsumes this focus on models of teaching is that of the instruction-oriented activities; accordingly, the feature of Type III MLR which relates most directly to teaching styles is that of the instructional-component emphasis. One justifiable direction for Type III MLR, then, would be that of exploring (a) the various models of teaching as each relates to a group-based and/or individual-based format and (b) selected aspects of the various models as they can be incorporated into the prescription of learning correctives and/or learning enrichment.

When the areas of student learning styles and models of teaching are considered in combination, one in effect arrives at an extremely comprehensive framework for ATI research which involves both the student-entry characteristic and instructional-component features of Type III MLR.

In Search of a Macro-Model for Studying/Advancing Mastery Learning

As indicated at the outset of this paper, a major objective has been to demonstrate certain logical relationships that exist among such areas as the science of teaching, instructional psychology, and the multifaceted aspects of mastery learning. Table 3 suggests one possible way of conceptualizing a model at the macro-level which might serve as a basis for studying/advancing mastery learning. Those

Insert Table 3 about here

components of the macro-model labelled "Global Dimensions of Mastery Learning" and "Instructional Psychology Contributors to Mastery Learning" have been treated in sufficient detail throughout this paper. That component labelled "Foundational Disciplines for Mastery Learning," however, has not been discussed explicitly herein but instead represents an implied notion that should be apparent as one delves deeply into the other two components. Essentially, this third component suggests that mastery learning, by its very nature, is rooted in several foundational disciplines; namely, philosophy, psychology, history, and sociology. This is not intended as an all inclusive list but simply as an enumeration of those academic disciplines which are most directly related to supporting and advancing mastery learning in particular and the science of teaching in general.

Concluding Remarks

Effective teaching may be characterized from two different perspectives which relate to process and product dimensions but which are not mutually exclusive. From the process-oriented view, teaching represents the design of an educational environment which encourages and facilitates learning; from the product-oriented standpoint, teaching involves the efficient instrumental causation of learning. Consistent with each viewpoint is the contention that teaching encompasses an artistic feature as well as a scientific basis. The former relates

specifically to the notion that teaching is a cooperative art in that teaching helps nature do what it can do itself--though not as well--without it; the latter pertains to that multidisciplinary accumulation of systematic knowledge which makes possible the prediction and control of human behavior as it relates to the events comprising instruction and learning.

This paper suggested that any responsible discussion of the science of teaching must give serious consideration to those contributions made by the conceptual, functional, and research dimensions of mastery learning. It was further maintained that these contributions of mastery learning must be viewed in the context of instructional psychology if one is to grasp the "grand mosaic" through which mastery learning impacts the science of teaching. Accordingly, mastery learning was discussed in terms of the following: (a) a set of optimistic assumptions regarding the capability of students to learn the contents of a course/unit to a high degree of competency provided that the learning conditions are maximized, (b) an array of functions or purposes served by those instructional components comprising the preparatory, delivery, and evaluative tasks of diagnostic-prescriptive teaching, and (c) a taxonomy of research questions providing direction to the analytical and/or empirical investigation of learner-oriented and instruction-oriented variables thought to be alterable. Instructional psychology was considered as a subsumer of mastery learning which most comprehensively relates the behavioral science of psychology to the enhancement of teaching and learning by focusing primarily on the following three global issues: (a) features of learning tasks,

(b) learner-oriented characteristics, and (c) instruction-oriented activities. Emanating from the field of instructional psychology and impacting quite comprehensively the essence of mastery learning are the following four areas of inquiry: instructional design, conditions of learning, student learning styles, and models of teaching. Each of these areas represents a point of merger between mastery learning and instructional psychology which further advances the scientific dimension of teaching.

The principal intent of this paper, then, was as follows: (a) to characterize the process, product, artistic, and scientific aspects of effective teaching, with a focus on the scientific; (b) to position the conceptual, functional, and research dimensions of mastery learning within the broader context of instructional psychology; (c) to suggest instructional design, conditions of learning, student learning styles, and models of teaching as areas of inquiry common to both mastery learning and instructional psychology; and (d) to propose the multi-disciplinary features of the mastery learning paradigm as crucial contributors to the science of teaching. Furthermore, a macro-model for studying/advancing mastery learning was suggested which incorporates the global dimensions of mastery learning (conceptual, functional, and research), the instructional psychology contributors to mastery learning (instructional design, conditions of learning, student learning styles, and models of teaching), and the foundational disciplines for mastery learning (philosophy, psychology, history, and sociology). If viewed as having been argued convincingly enough, this effort might serve to place the work of teachers and students on a more dependable and predictable basis rather than being at the mercy of chance factors.

Reference Note

1. Hymel, G. M. An instructional design model for guiding mastery learning research and development efforts. Paper presented at the annual meeting of the Mid-South Educational Research Association, Lexington, Kentucky, November 1981.

References

Adler, M. J. Great ideas from the great books. New York: Washington Square Press, 1963.

Anderson, L. W. Major assumptions of mastery learning. Paper presented at the annual meeting of the Southeast Psychological Association, Atlanta, March 1975. (ERIC Document Reproduction Service No. ED 150 172)

Anderson, L. W. Adaptive education. Educational Leadership, 1979, 37, 140-143.

Anderson, L. W., & Anderson, J. C. A functional approach to the definition of mastery learning. Paper presented at the annual meeting of the American Educational Research Association, New York City, March 1982.

Anderson, L. W., & Block, J. H. Mastery learning. In D. J. Treffinger, J. K. Davis, & R. E. Ripple (Eds.), Handbook on educational psychology. New York: Academic Press, 1977.

Anderson, L. W., & Block, J. H. The mastery learning model of teaching and learning. In T. Husen & T. N. Postlethwaite (Eds.), International encyclopedia of education: Research and studies. Oxford: Pergamon Press, 1983.

Anderson, L. W., & Jones, B. F. Designing instructional strategies which facilitate learning for mastery. Educational Psychologist, 1981, 16, 121-138.

Aquinas, T. /De veritate (Truth)/ (3 vols.). (J. V. McGlynn, R. W. Mulligan, & R. W. Schmidt, trans.). Chicago: Henry Regnery Co., 1952-1954.

Atkinson, R. C. Ingredients for a theory of instruction. American Psychologist, 1972, 27, 921-931.

Atkinson, R. C. Adaptive instructional systems: Some attempts to optimize the learning process. In D. Klahr (Ed.), Cognition and instruction. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1976.

Block, J. H. (Ed.). Mastery learning: Theory and practice. New York: Holt, Rinehart, & Winston, Inc., 1971.

Block, J. H. Teachers, teaching and mastery learning. Today's Education, 1973, 63(7), 30-36.

Block, J. H. (Ed.). Schools, society, and mastery learning. New York: Holt, Rinehart, & Winston, 1974.

Block, J. H. Individualized instruction: A mastery learning perspective. Educational Leadership, 1977, 34, 337-341.

Block, J. H. Mastery learning: The current state of the craft. Educational Leadership, 1979, 37, 114-117.

Block, J. H. Promoting excellence through mastery. Theory into Practice, 1980, 19, 66-74.

Block, J. H., & Anderson, L. W. Mastery learning in classroom instruction. New York: Macmillan Publishing Co., 1975.

Block, J. H., & Burns, R. B. Mastery learning. In L. S. Shulman (Ed.), Review of research in education (4th ed.). Itasca, Illinois: F. E. Peacock Publishers, Inc.-AERA, 1976.

Bloom, B. S. Learning for mastery. (UCLA-CSEIP) Evaluation Comment, 1968, 1, 2.

Bloom, B. S. Individual differences in school achievement: A vanishing point? (A Phi Delta Kappa Monograph). Bloomington, Indiana: Phi Delta Kappa International, 1971. (a)

Bloom, B. S. Mastery learning and its implications for curriculum development. In E. W. Eisner (Ed.), Confronting curriculum reform. Boston: Little, Brown & Co., Inc., 1971. (b)

Bloom, B. S. Human characteristics and school learning. New York: McGraw-Hill, 1976.

Bloom, B. S. New views of the learner: Implications for instruction and curriculum. Educational Leadership, 1978, 35, 563-568; 570-576.

Bloom, B. S. All our children learning. New York: McGraw-Hill Book Co., 1980.

Briggs, L. J. (Ed.). Instructional design: Principles and applications. Englewood Cliffs, N. J.: Educational Technology Publications, 1977.

Carroll, J. B. A model of school learning. Teachers College Record, 1963, 64, 723-733.

Cronbach, L. J., & Snow, R. E. Aptitudes and instructional methods: A handbook for research on interactions. New York: Irvington Publishers, Inc., 1977.

Dick, W., & Carey, L. The systematic design of instruction. Glenview, Illinois: Scott, Foresman & Co., 1978.

Dunn, R., & Dunn, K. Teaching students through their individual learning styles: A practical approach. Reston, Va.: Reston Publishing Co., Inc., 1978.

Gage, N. L. The scientific basis of the art of teaching. New York: Teachers College Press, 1978.

Gagné, R. M. Essentials of learning for instruction. Hinsdale, Illinois: The Dryden Press, 1974.

Gagné, R. M. The conditions of learning (3rd ed.). New York: Holt, Rinehart, & Winston, 1977.

Gagné, R. M., & Briggs, L. J. Principles of instructional design (2nd ed.). New York: Holt, Rinehart, & Winston, 1979.

Gagné, R. M., & Dick, W. Instructional psychology. In M. R. Rosenzweig & L. W. Porter (Eds.), Annual review of psychology (Vol. 34). Palo Alto, Calif.: Annual Reviews, Inc., 1983.

Gagné, R. M., & Rohwer, W. D., Jr. Instructional psychology. In P. H. Mussen & M. R. Rosenzweig (Eds.), Annual review of psychology (Vol. 20). Palo Alto, Calif.: Annual Reviews, Inc., 1969.

Gehlbach, R. D. Individual differences: Implications for instructional theory, research, and innovation. Educational Researcher, 1979, 8(4), 8-14.

Glaser, R. Components of a psychology of instruction: Toward a science of design. Review of Educational Research, 1976, 46, 1-24.

Glaser, R. (Ed.). Advances in instructional psychology (Vol. 1). Hillsdale, N. J.: Lawrence Erlbaum Associates, Publishers, 1978.

Glaser, R. (Ed.). Advances in instructional psychology (Vol. 2). Hillsdale, N. J.: Lawrence Erlbaum Associates, Publishers, 1982.

Glaser, R., & Resnick, L. B. Instructional psychology. In P. H. Mussen & M. R. Rosenzweig (Eds.), Annual review of psychology (Vol. 23). Palo Alto, Calif.: Annual Reviews Inc., 1972.

Gregorc, A. F. Learning/teaching styles: Potent forces behind them. Educational Leadership, 1979, 36, 234-236. (a)

Gregorc, A. F. Learning/teaching styles: Their nature and effects. In National Association of Secondary School Principals (NASSP), Student learning styles: Diagnosing and prescribing programs. Reston, Va.: NASSP, 1979. (b)

Hill, J. E. Cognitive style as an educational science. Bloomfield Hills, Mich.: Oakland Community College Press, 1970.

Hill, J. E. The educational sciences: A conceptual framework. West Bloomfield, Mich.: Hill Educational Sciences Research Foundation, 1981.

Hunt, D. E. Matching models in education. Toronto: Ontario Institute for Studies in Education, 1971.

Hunt, D. E. Conceptual level theory and research as guides to educational practice. Interchange, 1977-78, 8, 78-90.

Hymel, G. M. Aquinas on the role of the teacher: Implications for instructional design. Louisiana Philosophy of Education Journal (Proceedings of the 3rd Annual Meeting of the Louisiana Philosophy of Education Society), 1976, 2, 28-33.

Hymel, G. M. Accountability in the classroom: A consideration of its underlying principle and implications. Journal of the Louisiana Philosophy of Education Society (Proceedings of the 5th Annual Meeting of the Louisiana Philosophy of Education Society), 1978, 4, 1-8.

Hymel, G. M. Causality in the classroom: A Thomistic viewpoint. Louisiana Philosophy of Education Journal (Proceedings of the 6th Annual Meeting of the Louisiana Philosophy of Education Society), 1979, 5, 65-74.

Hymel, G. M. A systems-based model for designing instruction. NASSP Bulletin, in press.

Joyce, B. R. Selecting learning experiences: Linking theory and practice. Washington, D. C.: Association for Supervision and Curriculum Development, 1978.

Joyce, B. R., Brown, C. C., & Peck, L. (Eds.). Flexibility in teaching: An excursion into the nature of teaching and training. New York: Longman Inc., 1981.

Joyce, B., & Weil, M. Models of teaching (2nd ed.). Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1980.

Keefe, J. W. Learning style: An overview. In National Association of Secondary School Principals (NASSP), Student learning styles: Diagnosing and prescribing programs. Reston, Va.: NASSP, 1979.

McKeachie, W. J. Instructional psychology. In M. R. Rosenzweig & L. W. Porter (Eds.), Annual review of psychology (Vol. 25). Palo Alto, Calif.: Annual Review Inc., 1974.

Merrill, M. D. (Ed.). Instructional design: Readings. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1971.

Resnick, L. B. Instructional psychology. In M. R. Rosenzweig & L. W. Porter (Eds.), Annual review of psychology (Vol. 32). Palo Alto, Calif.: Annual Reviews Inc., 1981.

Snow, R. E. Individual differences and instructional theory. Educational Researcher, 1977, 6(10), 11-15.

Wittrock, M. C. The cognitive movement in instruction. Educational Researcher, 1979, 8(2), 5-11.

Wittrock, M. C., & Lumsdaine, A. A. Instructional psychology. In M. R. Rosenzweig & L. W. Porter (Eds.), Annual review of psychology (Vol. 28). Palo Alto, Calif.: Annual Reviews Inc., 1977.

Footnote

The research for this paper was supported in part by a Loyola University Faculty Research Grant and was done in conjunction with the research/evaluation function of the Loyola Center for Educational Improvement.

Table 1

Process-Product and Artistic-Scientific

Aspects of Effective Teaching

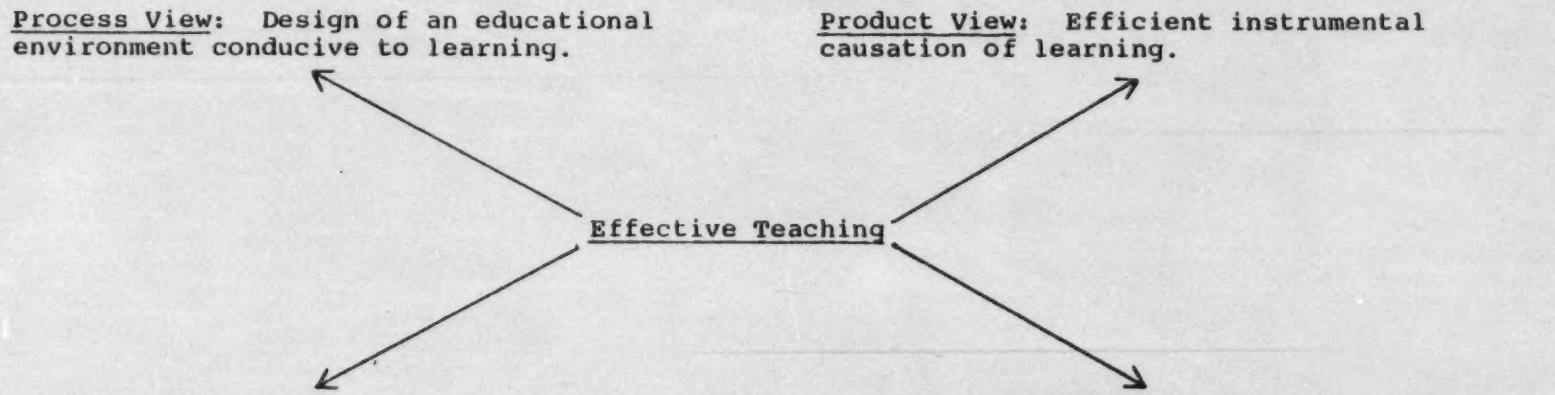
Process View: Design of an educational environment conducive to learning.
Product View: Efficient instrumental causation of learning.
Effective Teaching
Artistic Dimension:
1. Cooperative Art: Helps nature to accomplish what it can do itself--though not as well--without it.
2. Practical Art: Accomplishes something useful via an appeal to intuition, creativity, improvisation, and expressiveness.
Scientific Dimension:
1. Multidisciplinary accumulation of systematic knowledge emanating primarily from psychology, sociology, philosophy, history, and anthropology.
2. Prediction and control of human behavior as it relates to teaching and learning.
3. Relationships between teacher-behavior variables and student-behavior variables established analytically and/or empirically.

Table 2

Student Learning Style

Cognitive Styles

Reception Styles

[a]*Perceptual modality preferences
*Field independence vs. dependence
Scanning
Constricted vs. flexible control
Tolerance for incongruous or unrealistic experiences
Strong vs. weak automatization
Conceptual vs. perceptual-motor dominance

Concept Formation and Retention Styles

*Conceptual tempo
Conceptualizing styles
Breadth of categorizing
Cognitive complexity vs. simplicity
*Leveling vs. sharpening

Affective Styles

Attention Styles

*Conceptual level
Curiosity
Persistence or perseverance
Level of Anxiety
Frustration tolerance

Expectancy and Incentive Styles

*Locus of control
*Achievement motivation
Self-actualization
Imitation
Risk taking vs. cautiousness
Competition vs. cooperation
Level of aspiration
Reaction to reinforcement
*Social motivation
Personal interests

Physiological Styles

*Masculine-feminine behavior
Health-related behavior
Time rhythms
Need for mobility
Environmental elements

Note. From "Learning Styles: An Overview" by J. W. Keefe, in National Association of Secondary School Principals (NASSP), Student learning styles: Diagnosing and prescribing programs. Reston, Va.: NASSP, 1979. Copyright 1979 by NASSP. Reprinted by permission.

[a]Asterisks refer to styles with best potential for improving learning.

Table 3

A Macro-Model for Studying/Advancing Mastery Learning